Tobacco consumption in relation to causes of death in an urban population of north India

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Background: Noncommunicable diseases have become a public heath problem in India concomitant with economic development, leading to increases in tobacco consumption, obesity, and changes in diet and lifestyle. Although observation suggests that tobacco consumption is a major risk factor for deaths due to circulatory, pulmonary, and malignant diseases, such studies are not available from most populations in developing countries.

Subjects and methods: For the period 1999–2001, we studied the randomly selected records of death of 2222 (1385 men and 837 women) decedents, aged 25–64 years, out of 3034 death records overall from the records at Municipal Corporation, Moradabad. All the families of these deceased could be contacted individually to find out the causes of death, by scientist/doctor administered, informed consented, verbal autopsy questionnaire, completed with the help of the spouse and local treating doctor practicing in the appropriate healthcare region. Social classes and tobacco intakes were assessed by a questionnaire.

Results: The prevalence of tobacco consumption, including chewing + smoking, were 45% (n = 623) among men and 15% (n = 125) among women decedents. However, smoking was observed in 20% and tobacco chewing in 30% of male decedents, while only 6% of female decedents smoked and 10% chewed tobacco. Social class had no impact on tobacco consumption in men but did influence one subgroup >55 years among women, ie, among those who had the highest tobacco consumption. Tobacco intakes were significantly more common among decedents dying due to circulatory, malignant, and pulmonary diseases, compared with other causes (men 61.1%, 76.6%, pulmonary 77.3% vs 31%, $P < 0.001$; women 27.5%, 75.9%, pulmonary 24.6% vs 0.42%, $P < 0.001$) of mortality, respectively. Pulmonary causes included chronic bronchitis and asthma. Circulatory diseases (29.1%, n = 646) including heart attacks (10.0%), stroke (7.8%), valvular heart disease (7.2%, n = 160), sudden cardiac death and inflammatory cardiac disease, each (2.0%, n = 44) were the second most common causes of deaths, after infections (41.1%, n = 915). Malignant neoplasm (5.8%, n = 131), injury (14.0%, n = 313), and miscellaneous causes of deaths, including diabetes mellitus (2.2%, n = 49) were noted in 9.1%, (n = 202) of death records. Cancers of the lung (1.6%), oral cavity (1.5%), liver (1.1%), stomach (0.9%), breast (0.31%), uterus, cervix, and ovary (0.27%) were relatively common causes for deaths due to malignancy.

Conclusions: This study shows that tobacco consumption appears to be a major contributor to deaths due to circulatory diseases and malignant diseases in India. Social class status had little impact on tobacco consumption in male decedents. Rapid changes in diet and lifestyle, increases in tobacco consumption, and possibly aging of the population, appear to be strongly associated with mortality due to cardiovascular diseases and cancer in this middle-income country.

Keywords: tobacco chewing, mortality, cause of death, socioeconomic status, risk factors, urban deaths

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Introduction

There is scanty evidence regarding the causes of deaths in developing countries, although hospital records indicate a rapid increase in mortality and morbidity from

cardiovascular disease (CVD), pulmonary diseases, and cancer, possibly due to rapid changes in diet and lifestyle and increases in tobacco consumption (Singh et al 1997a, 1997b; Yusuf et al 2001a, 2001b; Sachs 2004; WHO 2005). Tobacco consumption is a worldwide cause of CVD, benign obstructive lung diseases, and cancer mortality, especially for lung cancer (Peto et al 1994; Singh et al 1997a, 1997b, 1997c; Kesteloot 2003; INTERHEART 2006). In developed countries (Gupta et al 1980, 1984; Berger and Wynder 1994; Peto et al 1994; Cavelaars et al 1997; Singh et al 1997a, 1997b; Foley et al 2002; Kesteloot 2003; Puska et al 2003; Schiaffino et al 2003; Schoenborn et al 2003), it is also known that lower social or educational classes have a higher prevalence of smokers, obesity, alcoholism, and lower intakes of fruits and vegetables and less spare time spent on physical activity. In one study (CDC 2006) conducted between 1997–1998, data on cigarette smoking in adults in the United States showed that white men were smokers less frequently than black men and the reverse was found for white women compared with black women. The prevalence and extent of tobacco consumption are much greater in other developing and developed countries compared with India (Gupta et al 1980, 1984; Berger and Wynder 1994; Peto et al 1994; Cavelaars et al 1997; Singh et al 1997a, 1997b; Foley et al 2002; Kesteloot 2003; Puska et al 2003; Schiaffino et al 2003; Schoenborn et al 2003; CDC 2006; Gerber et al 2006; INTERHEART 2006). In an Indian study, tobacco consumption was observed among 27.5% (n = 249) of men and 11.6% (n = 105) of women (Singh et al 1997c). In rural populations, tobacco consumption is more common than in urban areas (Singh et al 1997a, 1997b).

Circulatory, pulmonary, and malignant diseases have already become important as a cause of death in most developing economies of the world, and are likely to assume greater importance in the near future (Yusuf et al 2001a, 2001b; Sachs 2004; WHO 2005). Mortality due to CVD is declining in developed countries with only small changes in cancer deaths and in deaths among the elderly and women (CDC 2006; Gerber et al 2006). In developed countries, higher social classes as compared with lower social classes experience greater cardiovascular, pulmonary, and cancer mortality, as well as deaths due to all other causes (Kesteloot 2003; CDC 2006; Gerber et al 2006; INTERHEART 2006). In the present study, we report the prevalence of tobacco consumption among decedents due to circulatory and chronic lung diseases and cancers, based on verbal autopsy questionnaire, in an urban population of north India.

Subjects and methods

The subjects and methods for the present study have been described in detail elsewhere (Singh et al 2002, 2005). In brief, the city of Moradabad is an urban area with a population of 0.641 million residing in 306 streets or 60 wards. Causes of death recorded at the municipal board might not be correct as these are based on certificates issued by the attending doctors, without confirmation by autopsy. We studied the records of 2842 randomly selected adult decedents, aged 25–64 years. During the last two years from July 1999 to July 2001, 2222 decedent's relatives could respond for this study. Of 2222 decedents, 1385 were male and 837 were female. All the families of these 2222 victims were contacted individually to find out the causes of deaths by verbal autopsy questionnaire (Singh et al 2002, 2005). Since autopsy is not possible in many developing countries due to religious considerations, WHO has suggested investigating causes of death by detailed questionnaires administered to spouses and concerned doctors. The head of every family was personally called after communication with the help of the local accessible doctor in the healthcare region (lane). At least three calls, via letter/telephone and personal contact via lane doctor were made before any subject or family was declared a noncontact or nonreplier, ie, one in the morning, one in the evening around 1700 hrs, and the last one during the weekend.

Our team consisted of a scientist, a health worker, and a doctor, who were trained and briefed regarding the details of questionnaires before starting the survey. The case record forms were pretested by the concerned committee in roughly 30 to 60 families. It was found that 10% of the families who came within reach of survey were declared noncontacts or nonresponders as observed in other surveys (Singh et al 1997a, 1997b). We recorded the name, address, and if possible telephone numbers of the spouse, family doctor, and the doctor who treated the decedent at the time of death. Clinical data on age, sex, height, weight, marital status, occupation, education, past medical and family history, history of hypertension, diabetes, stroke, heart attack, alcohol intake, drug intake, tobacco intake, lung tuberculosis, bronchitis, asthma, cancer, mental diseases, diarrhea and dysentery, AIDS and renal, liver, brain, CVD, infectious diseases, and accidents, etc, were recorded. These clinical data were based on medical records of the decedent, death certificate issued by the doctor, interview of the participating doctor, and the family doctor, interview of the spouse and other family members, with the help of a consented questionnaire, to know the cause

of death. The following questions were asked to each of above persons:

1. What were the height, weight, waist and hip circumferences, blood pressures of the victim? (If such information was not given in the record.)
2. Please tell any other illness which the deceased had in the past? eg, tuberculosis, AIDS, hypertension, diabetes, heart attack, obesity, paralysis, asthma, chronic bronchitis, pneumonia, previous blood pressure, cancer, any surgery or injury, etc (to determine the primary cause of illness.)
3. Please describe the most important symptoms at the onset of illness: eg, fever, headache, severe pain anywhere in the body, seizures, etc
4. Please describe the most important symptoms at the time of death: eg, breathlessness, chest pain, unconsciousness, high fever, jaundice, anemia, bleeding, diarrhea, vomiting, etc.
5. Please describe the diagnosis of the illness made by the doctor. Was there any differences in the opinions of the doctors?

The socioeconomic status of the family was classified based on attributes of housing condition, education, occupation, per capita income, and ownership of consumer durables like a car, television, etc, in the household (Singh et al 1997d). Per capita income was calculated by dividing the total income of the family by the number of family members. Socioeconomic status (SES) 1 was the highest social class and SES 5 the lowest social class. The diagnosis of risk factors was based on available records, inquiry from the spouse, and concerned doctors, and the criteria of diagnosis were based on our earlier studies (Singh et al 1997a, 1997b). Tobacco consumption was determined based on criteria (Singh et al 1997c) used in other studies. Tobacco is consumed in various forms in India, such as cigarettes, beedi, the Indian pipe, in a raw or chewing form. People may consume tobacco in more than one form. Indian criteria classify subjects on the basis of smoking of cigarettes and pipes and do not adequately consider tobacco chewing, which has been duly considered by us (Singh et al 1997c).

Statistical analysis

We used the chi square test for the comparison of two groups. Only P values < 0.05 and two tailed t-tests were considered significant in both sexes.

Results

We assessed the data with the help of verbal autopsy questionnaire (Singh et al 2005) as suggested by the World Health Organisation (WHO) for countries where autopsy can not be done due to religious considerations. Table 1 shows the demographic data from the records and assessed by questionnaire, among 2222 decedents, aged 25–64 years, expiring due to various causes. The mean age, sex, and body mass index were slightly higher among decedents than in the urban population reported in other studies from our town (Singh et al 1997a, 1997b). There was a three-fold higher prevalence of tobacco intake, among men compared with women, and all forms of tobacco consumption, ie, smoking, chewing, and smoking and chewing were more common among men than among women (Table 1). Tobacco consumption among decedents in relation to age groups revealed that tobacco use by men was significantly more common in the age groups 35–44 years and >55 years of age. In comparison, women >55 years of age consumed tobacco more often compared with other age groups (Table 2).

Table 3 shows that tobacco consumption did not significantly differ among various social classes in men, although the prevalence was slightly lower among social class 4 men. Among women, tobacco consumption was significantly more

Table 1 Clinical data and tobacco consumption among decedents studied, based on records and assessment by questionnaire

Clinical data	Male (n = 1385)		Female (n = 837)	
	Mean (Standard deviation)			
Age	42.12**	(13.02)	40.05	(11.60)
Body weight	60.12**	(6.24)	53.10	(6.95)
Body mass index (kg/m)	23.18*	(2.18)	23.65	(2.46)
Tobacco consumption				
	No.	(%)	No.	(%)
Smoking	277	20*	50	6.0
Tobacco chewing	415	30*	83	10
Smoking & tobacco chewing	623	**45***	125	15

Note: *P < 0.05; **P < 001; P value was obtained by analysis of variance for comparison of means and by Chi square test (P < 0.02) by comparison of percentages of men and women. (Records of data were available only in 70%–80% of subjects. The rest were assessed by questioning the spouse and the lane doctors of the deceased).

Table 2 Tobacco consumption among decedents in relation to age groups

Age groups	Men (n = 1385)		Women (n = 837)		Total (n = 2222)	
	n		n		n	
25–34	735	214 (29.1)	462	80 (17.2)	1197	294 (24.6)
35–44	420	313 (74.0)*	247	25 (10.1)	667	338 (50.7)
45–54	189	66 (34.0)	98	14 (14.2)	287	80 (27.9)
>55	61	30 (49.2)*	30	6 (20.0)*	91	36 (39.6)
Total	1385	623 (45.0)	837	125 (15.0)	2222	748 (33.7)

Notes: Values are no. (%) of decedents consuming tobacco; *P < 0.05, P value obtained by Chi square test.

common among social classes 4 and 5 compared with higher social classes. Causes of death by social class and tobacco consumption are given in Table 3. In our study, circulatory diseases were the common cause of death in both sexes, ie, 29.3% in men, 28.6% in women, respectively.

Malignant diseases were also major causes of death in both men (5.5%) as well as in women (6.4%). Chronic bronchitis and asthma as the causes of death were noted among 7.0% (n = 97) men and 7.7% (n = 65) women. Circulatory diseases and diabetes as the cause of death were observed in 31.3% (n = 695) of the decedents. Other causes of death such as infections (41.1%, n = 915), injury (14.0%, n = 313), pregnancy and prenatal (0.72%, n = 15), miscellaneous (9.12%, n = 202) were observed among social classes 4 and 5, in both sexes (Table 3). Social classes 1–3 were significantly associated with deaths due to circulatory diseases in both sexes compared with social classes 4 and 5. However, deaths due to cancers were significantly more common among social class 1 women (breast cancer) without such an association in men (Table 3).

The incidence of tobacco consumption among decedents expiring due to various diseases related to circulatory, pulmonary, and malignant causes are given in Table 4. The incidence of tobacco users was significantly greater among decedents expiring due to stroke, heart attack and sudden cardiac death (death occurring within 1 hour of the onset of symptoms) in both sexes, compared to nonusers among these decedents. Tobacco use was also significantly more common among decedents due to cancers of the lung, oral cavity, and liver in men and lung, oral cavity, stomach, and breast in women. Similarly, tobacco users were significantly more common among decedents due to chronic bronchitis and asthma.

Comparing tobacco consumption among decedents in relation to cause of death determined that smoking, chewing, and smoking as well as chewing were independently associated with circulatory, pulmonary (chronic bronchitis and asthma), and malignant causes of death without such an association with other causes of mortality (Table 5).

Table 3 Tobacco consumption among decedents due to various causes by social classes

Social classes,1–5.	n	Tobacco	Circulatory	Malignant	Chronic bronchitis	Others
			Men, n (%)			
SES-1	264	153(58.0)	119(45.1)*	16(6.1)	18(6.8)	111(42.0)
SES-2	345	176(51.0)	158(45.8)*	16(4.6)	20(5.8)	151(43.4)
SES-3	290	138(47.6)	95(32.8)*	19(6.6)	22(7.6)	154(53.1)
SES-4	277	118(42.6)	30(10.8)	15(5.4)	18(6.5)	214 (77.3)*
SES-5	209	107(51.2)	4(1.9)	11(5.3)	19(9.1)	175 (83.7*)
Total	1385	692(50.0)	406(29.3)	77(5.6)	97(7.0)	805 (58.1)
			Women, n (%)			
SES-1	163	22(13.5)	80(49.1)*	16(9.8)*	12 (7.4)	55 (33.7)
SES-2	221	34(15.4)	108(48.9)*	12(5.4)	16 (7.2)	85(38.5)
SES-3	169	19(11.2)	37(21.9)*	12(7.1)	10 (5.9)	110 (65.0)
SES-4	159	31(19.5)*	10(6.3)	10(6.3)	17 (10.7)*	122 (76.7)*
SES-5	125	27(21.6)*	5(4.0)	4(3.2)	10 (8.0)*	106 (84.8)*
Total	837	133(15.9)	240(28.7)	54(6.5)	65 (7.8)	478 (57.1)
Grand total	2222	825(37.1)	646(29.1)	131(5.9)	162(7.3)	1283 (57.7)

Note: *P < 0.04 by comparison of SES 1–3 with SES 4, 5 and men and women; n = additions of circulatory, malignant, chronic bronchitis and asthma, and other causes of death excluding tobacco.
Abbreviations: SES, socioeconomic status.

Discussion

This study shows that the prevalence of tobacco consumption was significantly greater among victims dying due to circulatory and pulmonary diseases and malignancy compared with deaths due to other causes (Table 4, 5). Tobacco consumption of various types was three-fold greater among men compared with women (Table 1). Tobacco smoking and chewing was more commonly associated with decedents due to circulatory and pulmonary diseases and cancers, than with smoking and chewing of tobacco, independently (Table 5). However chewing of tobacco was also independently associated with these deaths compared with other causes of death. Tobacco chewing was also a cause of cardiovascular death in the INTERHEART study (2006).

According to Indian Council of Medical Research estimates, the annual estimated mortality due to tobacco-related diseases varies between 630,000 and one million. At any point of time, there are about 374,000 cancer patients, 1.89 million patients with coronary artery disease (CAD), and 4.8 million patients with chronic obstructive pulmonary disease, attributable to tobacco usage. Taking a conservative estimate of a two-fold risk of smokers developing CAD, the number of cases attributable to smoking would be nearly 1.3 million or 15% of the present CAD cases (Singh et al 1999; Shah 2005).

The exact prevalence of tobacco consumption, particularly in relation to mortality, is not available from various parts of India (Gupta et al 1980; Peto et al 1994). Various methods of tobacco use such as cigarette, beedi, and hukka (water-pipe) smoking and tobacco chewing are common in different parts of India (Gupta et al 1980, 1984; Singh et al 1997a, 1997b, 1997c). The prevalence of smoking varies between 20%–58% as reported in different studies from India (Gupta et al 1980, 1984; Singh et al 1997a, 1997c). Smoking is least common among Indian women, but tobacco chewing is common among 10%–30% of women in India. The adverse effects of tobacco chewing on heart disease are not known, however, age adjusted mortality rates were higher (Gupta et al 1980). The risk associated with beedi smoking has been estimated to be similar to cigarette smoking in various studies (Gupta et al 1980, 1984; Singh et al 1997c). Tobacco chewing, beedi, and hukka smoking appears to be more common in rural populations, whereas cigarette smoking and chewing of flavored tobacco are more common in the urban population of India (Singh et al 1997a, 1997b, 1997c; Jindal 2006a, 2006b). In one population study (Jindal 2006a) among 73,605 subjects, the prevalence of smoking was 28.5% (n = 10,756) in men and 2.1% (n = 740) in women. Beedi was the commonest form of smoking, more so in the rural areas. Increasing age, low socioeconomic status and

Table 4 Incidence of tobacco consumption among decedents due to various noncommunicable diseases

Cause of death	Men (n = 1385)			Women (n = 837)			Total (n = 2222)		
	n	Tobacco users	No tobacco	n	Tobacco users	No tobacco	n	Tobacco users	No tobacco
Circulatory diseases									
Stroke	115	102 (88.7)*	13 (11.3)	60	33 (55.0)*	27 (45.0)	175	135 (77.1)*	40 (22.9)
Heart attack	137	110 (80.3)*	27 (19.7)	85	47 (55.3)*	38 (44.7)	222	157 (70.7)*	65 (29.3)
Sudden cardiac death	25	18 (72)*	7 (28)	20	11 (55)*	9 (45)	45	29 (64.4)*	16 (35.6)
Valvular heart disease	105	10 (9.5)	95 (90.5)	55	1 (1.8)	54 (98.2)	160	11 (6.9)	149 (93.1)
Inflammatory cardiac disease	24	8 (33.3)	16 (66.7)	20	1 (5.0)	19 (95.0)	44	9 (20.5)	35 (79.5)
Total	406	248 (61.1)*	158 (38.9)	240	93 (38.8)	147 (61.3)	646	341 (52.8)	305 (47.2)
Malignant neoplasm	Men			Women			Total		
Lung cancer	24	21 (87.5)*	3 (12.5)	12	7 (58.3)*	5 (41.7)	36	28 (77.8)*	8 (22.2)
Oral cancer	23	19 (82.6)*	4 (17.4)	11	7(63.6)*	4 (36.4)	34	26 (76.5)*	8 (23.5)
Liver cancer	16	10 (62.5)*	6 (37.5)	10	5 (50.0)	5 (50.0)	26	15 (57.7)*	11 (42.3)
Stomach cancer	14	9 (64.3)*	5 (35.7)	8	5 (62.5)*	3 (37.5)	22	14 (63.6)*	8 (36.4)
Breast cancer	–	–	–	7	6 (85.7)*	1 (14.3)	7	6 (85.7)*	1 (14.3)
Uterus and Cervix cancer	–	–	–	4	2 (50.0)	2 (50.0)	4	2 (50.0)	2 (50.0)
Ovary cancer	–	–	–	2	2 (100.0)	0 (0.0)	2	2 (100.0)	0 (0.0)
Total	77	59(76.6)*	18 (23.4)	54	34(63.0)*	20 (37.0)	131	93 71.0)*	38 (29.0)
	Men (n = 92)			Women (n = 65)			Total (n = 162)		
Chronic bronchitis and asthma	97	75(77.3)*	22 (22.7)	65	22(33.8)	43 (66.2)	162	97(59.9)*	65 (40.1)

Note: P < 0.02; P values obtained by comparison of tobacco users and nontobacco users by Chi square test.

Table 5 Tobacco consumption among decedents in relation to cause of death

Tobacco intakes	Circulatory	Malignant	Chronic bronchitis and asthma	Others
		Men n (%)		
	n = 406	n = 77	n = 97	n = 805
Smoking & chewing (n = 623)	248 (61.1)*	59 (76.6)*	66 (68.0)*	250 (31.1)
Smoking (n = 277)	150 (36.9)*	55 (71.4)*	56 (57.7)*	16 (2.0)
Chewing (n = 465)	212 (52.2)*	50 (64.9)*	52 (53.6)*	151 (18.8)
	n = 610	n = 164	n = 174	n = 417
		Women n (%)		
	n = 240	n = 54	n = 65	n = 470
Smoking & chewing (n = 125)	66 (27.5)*	41 (75.9)*	16 (24.6)*	2 (0.42)
Smoking (n = 40)	21 (8.8)*	15 (27.8)*	3 (4.6)*	1 (0.21)
Chewing (n = 83)	40 (16.7)*	23 (42.6)*	16 (24.6)*	4 (0.85)

Note: *P < 0.001; P values obtained by Chi square test;Values are numbers (%).

rural area residence were important factors associated with beedi smoking. Smoking was significantly less common among urban compared with rural men (22.1 vs 36.1% in men and 3.8 vs 0.7% in women). Chronic obstructive lung disease was diagnosed in 4.1% of 35,295 subjects, with a male to female ratio of 1.56:1 and smoker to nonsmoker ratio 2.65:1. Prevalence rates among beedi and cigarette smokers were 8.2% and 5.9%, respectively (Jindal 2006b). Studies on the association of tobacco consumption with deaths due to noncommunicable diseases are rare from India (Gupta et al 1984; Singh et al 1997c).

The adverse effects of smoking may be because of nicotine, carbon monoxide, and other chemicals, which may enhance carcinogens and free radical generation (Gupta et al 1980, 1984; Kesteloot 2003; Peto et al 1994; Foley et al 2002; Puska et al 2003; Schiaffino et al 2003; Schoenborn et al 2003). Tobacco consumption also damages the taste buds in the oral cavity, which may be a factor in the observed decreases in intake of fruits and vegetables resulting in poor vitamin C and beta-carotine status among tobacco users (Gupta et al 1984).These effects are known to predispose to cardiovascular diseases and cancer (Gupta et al 1980, 1984; Singh et al 1997c; Foley et al 2002; Puska et al 2003; Schiaffino et al 2003; Schoenborn et al 2003).

In the United States between 1975 and 2000 about 11%–15% of the population lived below the poverty level (Kesteloot 2003; Schoenborn et al 2003). This level was about 13% during the period 1997–1998, with 25% for blacks and 10% for whites. Differences in smoking behavior among the races could influence the overall results (Berger and Wynder 1994; Cavelaars et al 1997; Foley et al 2002; Puska et al 2003; Schiaffino et al 2003; Schoenborn et al 2003). White men smoke less than black men (26.3% vs 30.4%) and the reverse holds true for white compared with black women (24.1% vs 21.6%). In Spain the higher educated men started smoking later and had lower smoking rates than the lower educated, especially in the periods 1978–1982 and 1988–1992. However, higher educated women started smoking earlier (period 1958–1962) than lower educated women. In the period 1988–1992 the smoking rates and initiation ages of higher educated women were very similar to those of men of the same educational level. Lower educated women smoked more and started smoking earlier than the higher educated women (Schiaffino et al 2003). In the period 1994–1998, representative national surveys were performed in Estonia, Finland, and Lithuania. Higher educated men had significantly ($p < 0.01$) lower smoking rates than lower educated men (OR 0.57, 0.43, 0.56, respectively). The same is true for women, with the exception of Lithuania (OR 0.62, 0.38, 1.29 [nonsignificant], respectively). Lithuanian women had the lowest smoking rates of the 3 countries considered (Puska et al 2003).

While CVD is a global killer, since the mid 1960s deaths from myocardial infarction have declined by more than 50% in many industrialized countries, and similar declines have occurred for stroke (Yusuf et al 2001a, 2001b; WHO 2002; Sachs 2004). In 1980, heart attack was the leading cause of death in the United States in the age cohort 45–64 and malignancy was second (Gupta et al 1980). Age-specific data from 2000 indicate that malignancy is now the leading cause of death from age 35 through 74, albeit with a reduction in numbers of cases by 7.4%, compared with 1980. Heart disease, now in second place in this age group, has fallen by 265% since 1980, and is now only the major cause of death after age 75. For heart disease, the age-adjusted death rate

has fallen by 67% (Yusuf et al 2001a, 2001b; WHO 2002; Sachs 2004).

In this study, tobacco consumption showed no significant differences in various social classes in men, although among women it was significantly more common among social classes 4 and 5 compared with higher social classes. Increased chewing of raw tobacco is common among lower social classes in India, whereas social class 1–3 prefer to chew flavored tobacco (Gupta et al 1980; Singh et al 1997a, 1997b, 1999). Causes of death by social class and tobacco consumption are given in Table 3. Circulatory diseases were the common cause of death in both sexes, ie, 29.3% in men and 28.6% in women, in our study. Malignant diseases were also major causes of death in men (5.5%) and in women (6.4%). Circulatory diseases and diabetes as cause of death were observed in 31.3% (n = 695) of the decedents. Chronic bronchitis and asthma as the causes of death were observed among 7.0% of men and 7.7% of women. Other causes of death such as infections (41.1%, n = 915), injury (14.0%, n = 313), pregnancy and prenatal (0.72%, n = 15), miscellaneous (9.12%, n = 202) were observed among social classes 4 and 5, in both sexes (Table 3). Social classes 1–3 were significantly associated with deaths due to circulatory diseases compared with social class 4 and 5, in both sexes. However, deaths due to cancers were significantly more common among social class 1 women (breast cancer) without such an association in men (Table 3). Our study shows that social class has become an important determinant of mortality in the urban population of north India (Singh et al 2005).

In the light of WHO estimates, it seems possible that there appears to be a decline in deaths due to infection, and increased death rate due to CVD and diabetes in higher social classes. Whereas in lower social classes infections remain the major cause of death (Gupta et al 1980; Singh et al 1997a, 1997b; Yusuf et al 2001a, 2001b; WHO 2002; Sachs 2004). This phenomenon may be due to aging of the population and economic development causing rapid changes in diet and lifestyle resulting in a nutritional transition from under-nutrition to over-nutrition (Yusuf et al 2001a, 2001b; WHO 2002; Sachs 2004; INTERHEART 2006). We also found that tobacco intake showed no social class differences among men. However, it was significantly associated with deaths due to circulatory diseases and cancers. It seems that the stage at which hypertension, diabetes, and coronary artery disease (CAD) and cancer emerge as significant causes of death, corresponds to a life expectancy level between 50–60 years and at this level cardiovascular mortality accounts for 15%–25% of all deaths (Yusuf et al 2001a, 2001b; WHO 2002; Sachs 2004). In developed countries (Foley et al 2002; Puska et al 2003; Schiaffino et al 2003; Schoenborn et al 2003), eg, in the United States during the same period (2001) among male and female subjects aged 25–64 years with an education level of 12 years, mortality ratios of 3.09 and 20.90, respectively, were reported as compared with those having higher educational levels. This finding is universal in the developed countries, but not in the developing countries because the developing economies have not yet learned the methods of prevention of diseases (Singh et al 1997a, 1997b; Yusuf et al 2001a, 2001b; WHO 2002; Sachs 2004). In south India, life expectancy has become as great as in developed countries, and there is a marked decrease in under-nutrition and deaths due to infections, but morbidity and mortality due to circulatory diseases are increasing (Yusuf et al 2001a, 2001b; WHO 2002; Sachs 2004; INTERHEART 2006). Level of education has become a very good indicator of social class in the Western world (Yusuf et al 2001a, 2001b; WHO 2002; Sachs 2004; INTERHEART 2006). There are several factors, which may explain the impact of social class on health in developed countries: smoking behavior, obesity, physical activity, nutrition, and psychosocial factors, with all favoring the higher social classes. In developing countries such as India, China, Sri Lanka, and Brazil, enormous occupational physical activity in lower social classes is protective against morbidity and mortality due to circulatory diseases while they continue to have more deaths due to infections and poor nutritional status. Unfortunately, the impact of better education due to lack of health education, possibly, has not yet started in these countries, as well as among Indian immigrants to developed countries (Balarajan 1991; Hahn 1992; Jha et al 1993). This delay has resulted in a marked increase in mortality and morbidity due to circulatory diseases and neoplasms with increase in social class in conjunction with improvement in nutritional status as observed in our study (Tables 3–5; INTERHEART 2006). Tobacco consumption was highest among young decedents (Table 2), which may be the cause of increased susceptibility in Indians to die from vascular diseases (Balarajan 1991; Hahn 1992; Jha et al 1993).

In India, life expectancy increased from 41.2 years in the decade 1951–1961, to 61.4 years for the 1991–1996 period, causing a great increase in the population at risk from mortality and morbidity due to noncommunicable diseases (Singh et al 1997a, 1997b, 1999; Yusuf et al 2001a, 2001b; WHO 2002; Kesteloot 2003; Sachs 2004; INTERHEART 2006). There has been a marked increase in tobacco production and consumption in the last four decades in India, according to various

national and world development reports (Singh et al 1997a, 1997b; Yusuf et al 2001a, 2001b; WHO 2002; Kesteloot 2003; Sachs 2004; INTERHEART 2006). Other experts (Yusuf et al 2001a, 2001b; WHO 2002; Sachs 2004; INTERHEART 2006) also indicate that in the heavily populated countries of China and India, that account for more than a third of the world's population, CVD and cancers dominate the death toll, with millions of deaths per year attributable to these causes in each country. In Latin America, the Caribbean, and the Middle East crescent, heart disease also contributes greatly to mortality (Yusuf et al 2001a, 2001b; WHO 2002; Sachs 2004; Shah 2005; INTERHEART 2006). Psychosocial factors, diet, tobacco, and sedentary behavior appear to be important causes of death due to circulatory diseases and cancers in both developed and developing countries. These populations need to learn the methods of prevention for which WHO and the International College of Cardiology are working hard independently. Estimated and projected mortality rates per 100,000 for India's population by the WHO indicate that in the year 2000, all causes of deaths should be 876 in men and 790 in women which should decrease to 846 in men and 745 in women by the year 2015. Circulatory disease were estimated to be 253 in men and 204 in women in the year 2000, and to increase to 295 in men and 239 in women by the year 2015. Similar increases in deaths due to neoplasms were estimated from the year 2000 to 2015; from 88 to 108 in men and from 74 to 91 in women, respectively (Yusuf et al 2001a, 2001b; WHO 2002; Sachs 2004; Shah 2005; INTERHEART 2006). These estimates cannot be applied to our small population sample in this study. The large mortality in percentage due to other causes is partly due to the relatively young age of the sample. Noninfectious diseases predominate at ages above 60 years, but many die early due to tobacco (Balarajan 1991; Hahn 1992; Jha et al 1993; Yusuf et al 2001a, 2001b; WHO 2002; Ma et al 2003; Sachs 2004; Mohan et al 2006). In our study, approximately 693 adult men and 418 women died in approximately one year, in this north Indian urban population (6.4 million) in the year 2000. The deaths due to circulatory diseases were 203 in men and 120 in women (not per 100,000, but total deaths) whereas deaths due to cancer were 38 in men and 27 in women, and due to chonic bronchitis and asthma were; 49 in men and 33 in women, in the year 2000.

In brief, the findings of our study indicate that tobacco consumption was significantly associated with deaths due to circulatory diseases, chronic bronchitis, asthma, and neoplasm in the urban population of north India. Tobacco consumption has become a public health problem in India in all social classes.

Acknowledgments

The Center of Nutrition Research, International College of Nutrition (Moradabad, India) provided financial support to conduct this study.

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